

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
6 January 2005 (06.01.2005)

PCT

(10) International Publication Number
WO 2005/001750 A2

(51) International Patent Classification⁷: **G06K 9/00**

(21) International Application Number:
PCT/IB2004/003274

(22) International Filing Date: 30 June 2004 (30.06.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/484,201 30 June 2003 (30.06.2003) US

(71) Applicant (for all designated States except US): **HONDA MOTOR CO., LTD.**? [JP/JP]; No. 1-1, 2-Chome Minamiaoyama, Minato-Ku, Tokyo, 107-8556 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KOSHIZEN, Takamasa**?; Honda Research Institute Japan, Co., Ltd., 8-1, Honcho, Wako-shi, Saitama 351-0114 (JP). **HEISELE, Bernd**? [DE/US]; Honda Research Institute US, 145 Tremont Street, Boston, MA 02111-1208 (US). **TSUJINO, Hiroshi**?; Honda Research Institute Japan Co., Ltd., 8-1 Honcho, Wako-shi, Saitama 351-0114 (JP).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM AND METHOD FOR FACE RECOGNITION

(57) Abstract: A face recognition system is provided with a component learning/extraction module, a component classifier training module, a knowledge base for component classification, a component extraction module, an object identification training module, a knowledge base for face identification and an object identification module. The component learning/extraction module receives image data of faces of individuals at various viewpoints and extracts component data at various viewpoints from the image data of faces of individuals at various viewpoints. The component classifier training module receives the component data at various viewpoints and produces results of classifier training of the component data at various viewpoints. The knowledge base for component classification stores the results of classifier training of the component data at various viewpoints. The component extraction module receives image data of faces of individuals at various viewpoints and extracts outputs of classification of the component data at various viewpoints, using the results of classifier training of the component data at various viewpoints, stored in the knowledge base for component classification. The object identification training module receives the outputs of classification of the component data at various viewpoints and determines indicator component for each of the individuals by Bayesian estimation in such a way that posterior probability of a predetermined attention class is maximized under the outputs of classification of the component data at various viewpoints. The knowledge base for face identification stores indicator components for the individuals. The object identification module receives the outputs of classification of the component data at various viewpoints and identifies faces of the individuals using the indicator components for the individuals stored in the knowledge base for face identification.

WO 2005/001750 A2

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
6 January 2005 (06.01.2005)

PCT

(10) International Publication Number
WO 2005/001750 A3

(51) International Patent Classification⁷: **G06K 9/00**

(21) International Application Number:
PCT/IB2004/003274

(22) International Filing Date: 30 June 2004 (30.06.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/484,201 30 June 2003 (30.06.2003) US

(71) Applicant (for all designated States except US): **HONDA MOTOR CO., LTD.** [JP/JP]; No. 1-1, 2-Chome Minamiaoyama, Minato-Ku, Tokyo, 107-8556 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KOSHIZEN, Takamasa** [—/JP]; Honda Research Institute Japan, Co., Ltd., 8-1, Honcho, Wako-shi, Saitama 351-0114 (JP). **HEISELE, Bernd** [DE/US]; Honda Research Institute US, 145 Tremont Street, Boston, MA 02111-1208 (US). **TSUJINO, Hiroshi** [—/JP]; Honda Research Institute Japan Co., Ltd., 8-1 Honcho, Wako-shi, Saitama 351-0114 (JP).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
2 June 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **SYSTEM AND METHOD FOR FACE RECOGNITION**

WO 2005/001750 A3 (57) Abstract: A face recognition system is provided with a component learning/extraction module, a component classifier training module, a knowledge base for component classification, a component extraction module, an object identification training module, a knowledge base for face identification and an object identification module. The component learning/extraction module receives image data of faces of individuals at various viewpoints and extracts component data at various viewpoints from the image data of faces of individuals at various viewpoints. The component classifier training module receives the component data at various viewpoints and produces results of classifier training of the component data at various viewpoints. The knowledge base for component classification stores the results of classifier training of the component data at various viewpoints. The component extraction module receives image data of faces of individuals at various viewpoints and extracts outputs of classification of the component data at various viewpoints, using the results of classifier training of the component data at various viewpoints, stored in the knowledge base for component classification. The object identification training module receives the outputs of classification of the component data at various viewpoints and determines indicator component for each of the individuals by Bayesian estimation in such a way that posterior probability of a predetermined attention class is maximized under the outputs of classification of the component data at various viewpoints. The knowledge base for face identification stores indicator components for the individuals. The object identification module receives the outputs of classification of the component data at various viewpoints and identifies faces of the individuals using the indicator components for the individuals stored in the knowledge base for face identification.